

CLAIMS

What is claimed is:

1. A method of fabricating a multi-level stack of semiconductor substrate elements, each of said elements including integrated circuitry, comprising:
providing a first semiconductor substrate element having a first side including integrated circuitry thereon and having a back side;
providing at least one second semiconductor substrate element having a first side including a plurality of integrated circuitry thereon and having a backside;
stacking said first semiconductor element and said at least one second semiconductor substrate element in a superimposed relationship having the back side of the first semiconductor substrate element facing the back side of the at least one second semiconductor substrate element aligning vertically said first semiconductor substrate element and the at least one second semiconductor substrate element to vertically align integrated circuitry on said first semiconductor substrate element and at least one of the plurality of integrated circuits on said at least one semiconductor substrate element; and severing from said stack transversely at least one dice pair comprising a die from said first semiconductor substrate element and an aligned second die from said at least one second semiconductor substrate element; and
adhesively attaching said first semiconductor substrate element and said at least one second semiconductor substrate element.
2. The method of claim 1, wherein said adhesive comprises a dielectric adhesive.
3. The method of claim 1, further including:
disposing a heat sink element between said first semiconductor substrate element and said at least one second semiconductor substrate element.
4. The method of claim 1, wherein said first substrate element and at least one second semiconductor substrate element, each element including locations defining discrete dice

or wafer portions severable from a first semiconductor substrate wafer and at least one second substrate wafer.

5. The method of claim 1, wherein said first semiconductor substrate element and the at least one second semiconductor substrate element each include a flat, and said vertical alignment is effected by aligning said flat of said first semiconductor substrate element and said flat of the at least one second semiconductor substrate element.

6. The method of claim 1, further comprising:
connecting a first die of said at least one dice pair to conductors of a substrate.

7. The method of claim 6, wherein said connection is selected from a group comprising reflowable metal elements, polymer elements having a conductive capability, and preformed lead-type elements.

8. The method of claim 6, further comprising:
connecting both dice of said at least one dice pair to conductors of said substrate.

9. The method of claim 1, further comprising:
connecting the second die of said at least one dice pair to conductors of said substrate through intermediate connection elements.

10. The method of claim 1, wherein said intermediate connection elements are selected from a group consisting of bond wires and traces of flex circuits.

11. The method of claim 10, further comprising:
connecting said at least one dice pair to conductors of a substrate and encapsulating said at least one dice pair thereafter.

12. A method of fabricating a multi-level stack of semiconductor wafer segments, each of said semiconductor wafer segments including integrated circuitry, comprising:

- providing a first semiconductor substrate segment having a first side including integrated circuitry thereon and having a back side;
- providing at least one second semiconductor substrate segment having a first side including a plurality of integrated circuits thereon and having a backside;
- stacking said first semiconductor substrate segment and said at least one second semiconductor substrate wafer in at least partially superimposed relationship to form a stack of semiconductor wafer segment;
- separating said stack to form at least two semiconductor wafer segment stacks, each said semiconductor wafer segment stack comprising a first semiconductor wafer segment having a side including integrated circuitry and a back side and at least one second semiconductor wafer segment having a side including integrated circuitry and a back side,
- stacking said at least two semiconductor wafer segment stacks in at least partially superimposed relationship;
- locating bond pads on said first semiconductor wafer segment of at least one of said at least two semiconductor wafer segment stacks on the side adjacent said at least one second semiconductor wafer segment of said at least one semiconductor wafer segment stack at a periphery thereof;
- forming a notch through said at least one second semiconductor wafer segment of said at least one semiconductor wafer segment stack, said notch extending between and substantially perpendicular to a circuitry side and a back side of said at least one second semiconductor wafer segment to provide access to at least one said peripheral bond pad of said first semiconductor wafer segment of said at least one semiconductor wafer segment stack;
- and
- adhesively attaching said first and said at least one second semiconductor wafer segments of said at least one semiconductor wafer segment stack.

13. The method of claim 12, further including:
stacking said semiconductor wafer segments of said at least one semiconductor wafer segment
stack with the integrated circuitry side of said first semiconductor wafer segment
proximate the back side of said at least one second semiconductor wafer segment; and
locating said bond pads on said integrated circuitry side of said first semiconductor wafer
segment.

14. The method of claim 12, further including:
adhesively attaching said first and said at least one second semiconductor wafer segments of said
at least one semiconductor wafer segment stack.

15. The method of claim 12, further including
disposing a heat sink element between said first and said at least one second semiconductor
wafer segments.

16. The method of claim 12, further comprising:
connecting at least one of said first and said at least one second semiconductor wafer segment to
conductors of a substrate.

17. The method of claim 16, wherein said connection comprises a connection element
selected from a group comprising bond wires and traces of flex circuits.

18. A method of fabricating a multi-level stack of semiconductor wafers, each of said
semiconductor wafers including integrated circuitry, comprising:
providing a first semiconductor wafer having a first side including integrated circuitry and
having a back side;
providing at least one other semiconductor wafer having a first side including integrated circuitry
and having a back side;

stacking said first semiconductor wafer and said at least one other semiconductor wafer in a superimposed relationship;
locating bond pads on said first semiconductor wafer of said stack on the side proximate said at least one other semiconductor wafer at a periphery thereof;
forming a notch through said at least one other semiconductor wafer, said notch substantially perpendicular to a circuitry side and a back side of said at least one other semiconductor wafer providing access to at least one said peripheral bond pads of said first semiconductor wafer of said stack; and
adhesively attaching said first semiconductor wafer and said at least one other semiconductor wafer.

19. The method of claim 18, further including:
stacking said first semiconductor wafer and said at least one other semiconductor wafer with a third semiconductor wafer, having the integrated circuitry side of said first semiconductor wafer segment proximate the back side of said third semiconductor wafer.

20. The method of claim 18, wherein said adhesively attaching said first semiconductor wafer and said at least one other semiconductor wafer comprises:
adhesively attaching said first semiconductor wafer and said at least one other semiconductor wafer with a dielectric adhesive.

21. The method of claim 18, further including:
disposing a heat sink element between said first semiconductor wafer and said at least one other semiconductor wafer.

22. The method of claim 18, further comprising:
connecting at least one of said first semiconductor wafer and said at least one other semiconductor wafer to conductors of a substrate.

23. The method of claim 22, wherein a direct electrical connection is achieved with a connection element selected from a group comprising bond wires and traces of flex circuits.

24. The method of claim 18, wherein said first semiconductor wafer and said at least one other semiconductor wafer are stacked with the integrated circuit side of said first semiconductor wafer facing the back side of said at least one other semiconductor wafer, and wherein said bond pads are located on the integrated circuit side of said first semiconductor wafer.